Pennsylvania Coastal Zone Management Program

DELAWARE RIVERKEEPER VOLUNTEER MONITORING OF THE PENNSYLVANIA COASTAL ZONE

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A REPORT OF THE PENNSYLVANIA DEPARTMENT OF ENVIRONMENTAL RESOURCES TO THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION PURSUANT TO NOAA AWARD NO. NA90AA-D-CZ515

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DELAWARE RIVERKEEPER

- Final Report -

VOLUNTEER MONITORING OF THE PENNSYLVANIA COASTAL ZONE

JANUARY 1993 - SEPTEMBER 1993

Title: Delaware Riverkeeper Network Citizen Monitoring Program

Contract # CZ1:92.03PD

CONTRACTOR: American Littoral Society/Riverkeeper

Background
Riverkeeper, an affiliate of the American Littoral Society (ALS), has been working since 1988 to help protect and restore water quality and natural resources in the Delaware River Watershed. The watershed encompasses over 12,750 square miles from Delaware Bay to Hancock, NY. Riverkeeper volunteers monitor 87 stations in the watershed from the Bay to the headwaters near Hancock, New York. All but seven of the Riverkeeper stations are located on Delaware tributaries.

This report reflects data collected at ten monitoring stations located on Delaware River tributaries in the estuary. These sites were established for Riverkeeper and the Pennsylvania Coastal Zone Management Program. In addition to the ten Riverkeeper/PACZM sites, 5 estuary sites in Pennsylvania have been monitored by Riverkeeper for the past two years. A copy of the Annual Estuary Data Report (May 1992-May 1993) which contains data from those sites will be be provided to PACZM January 1994.

Three of the Riverkeeper/PACZM sites have become permanent additions to the Riverkeeper estuary monitoring program. They are Marcus Creek, Otter Creek, and Stony Creek. Monitoring at the remaining 7 Riverkeeper/PACZM sites was terminated.

PACZM Program Design
Former Estuary Field Coordinator Tim Merkel began the site selection process and contact of potential volunteers monitors in November 1992. He left Riverkeeper early on in the study (January 1993) which created a delay in the volunteer training process. Fred Stine was hired as Estuary Field Coordinator in mid-January 1993 and saw the program through until monitoring for seven of the CZM sites ceased September 30, 1993.

Seven of the Riverkeeper-PACZM sites were monitored by high school students under the direction of their science teachers. The monitoring program served both as a hands-on experience for the students in their respective science classes and as a means of creating a sense of awareness and appreciation for their local streams. The remaining three sites were monitored by individuals who were recruited through press releases and public service anouncements.

While the stream monitoring was conducted every two weeks, extreme weather conditions (freezing and heavy rains) conspired to reduce the frequency of testing during late winter and early spring. In addition continuity of testing for some of the sites monitored by high school students deteriorated during the summer when schools were out of session.

Results and Analysis of Water Quality Parameters and Observations

Results collected by the volunteer monitors for the Riverkeeper - PACZM program are presented here. Summary data for each station are presented in tabular form for each parameter, as well as observations and general comments.

Volunteer Observations and Comments

Volunteers were trained to observe wildlife, weather conditions and general water and habitat conditions. Overall, the observations reported by volunteers paint a portait of degraded streams, which is consistent with reports by volunteers from other Riverkeeper estuary sites located in the Philadelphia region. Typical water quality problems occuring in Pennsylvania's Delaware Estuary Coastal Zone include: trash/litter; combined sewer overflows; wastewater discharges; polluted runoff; and streambank erosion. While most of the coastal zone streams flow through urban or industrial landscapes, some creek watersheds, such as Neshaminy and Ridley are undergoing rapid development resulting in increased wastewater discharges, stormwater flows and sediment pollution.

Most of the Riverkeeper/PACZM monitoring stations reported problems with litter and garbage in and along the streams. Five of the sites reported serious sediment pollution. Heavy algal blooms were also observed at some of the sites. Oil sicks were reported at Tacony-Frankford, Darby and Chester Creeks; and a soapy discharge was reported at Marcus Hook Creek. Wildlife sightings were mostly limited to urban species such as pigeons, gulls and rats. However a Double-crested Cormorant was observed at the Schuylkill River site. Reports for those stations that reported significant observations are included with the monitoring data.

Water Depth

Water depth in the Delaware River Estuary tributaries is influenced by a number of factors. The river is tidal below Morrisville, and water depth in the tidal portion of the river and its tributaries exhibits large fluctuations during the tidal cycle. In addition, seasonal variations in runoff and rainfall also affect water depth. Water depth is normally at a maximum during the spring, when snow-melt from upstream areas and spring rains make significant contributions. Storm events can have localized, short-term effects on water depth.

No specific trends or relationships between water depth and the other parameters measure were noted. The very dry conditions throughout the region during the late spring and summer of 1993 resulted in lower than normal levels for most area streams and the minimum depth at most stations was recorded during that period.

Several stations exhibited wide variations in water depth. The widest variation occurred at Schuylkill River where the minimum water depth recorded was .7 meters and the maximum depth was 13.2 meters. Other stations with differences between maximum and minimum depths exceeding 2 meters included Chester Creek, Darby Creek, Marcus Hook Creek, and Stony Creek.

Transparency

The transparency, or clarity of water is most often reported as the Secchi depth. This measurement is taken by lowering a circular white or black-and-white disk, 20 cm (8 inches) in diameter, into the water until it is no longer visible. Secchi disc transparency, or Secchi depth, corresponds to the depth where light intensity is 10 percent or less of surface levels, and approximates the lower limit of major photosynthetic activity. Through its effect on the photosynthesis process, light intensity helps determine the species of plants and other aquatic organisms that can survive. Although somewhat simplistic and subjective, Secchi depth probably best represents the conditions which are most readily visible for recreational uses.

Transparency is related to the transmission of light in water, and depends on both the absorption and scattering of light. The absorption of light in dark-colored waters reduces light transmission. Light scattering is usually a more important factor than absorption in determining transparency. Scattering can be caused by color, by particulate organic matter, including algal cells, and by inorganic materials, such as suspended clay particles in water. Suspended particulates are often the factor determining transparency in rivers.

Most transparency readings were between .1 and 1.0 meters, but no apparent trends were noted and the periods of both minimum and maximum transparency occurred at different times for different stations. Ridley Creek had the highest overall transparency with a mean of 2.7 meters for the sampling period. The maximum transparency recorded was 3.8 meters at Neshaminy Creek, where the mean transparency was 1.3 meters. The station with the lowest mean transparency was Stony Creek with a mean of 0.5 meters and a low value of 0.1 meters.

Temperature

Temperature affects a number of physical, chemical, and biological processes in natural waters. The temperature regime of a river is primarily a function of ambient air temperatures. While temperature is controlled primarily by climatic conditions, human activities such as wastewater and/or thermal discharges, can also have an influence. One of the most biologically-important temperature effects is the decrease in oxygen solubility with increasing temperature.

Temperature results for the monitoring period followed expected seasonal trends. Maximum temperatures for all stations were between 20.0 and 28.1 C and minimum temperatures were between 0.0 and 4.0 C at all stations (Note: these results do not include Ridley Creek and Chester Creek because of sparse data).
Many stations were sampled less frequently during the winter months, which tended to skew the annual means toward higher values. The mean temperatures for stations reporting data on most dates appeared to be in the range of 13 to 20 C.

pH
The hydrogen ion activity in water provides an indication of the balance between acids and bases in solution. Hydrogen ion activity in water is usually reported as its negative logarithm, or pH. The pH of natural waters is an important general water quality indicator because pH is a major factor affecting most chemical and biological reactions. Accepted water quality criteria indicate a pH of less than 6.5 units may be harmful to many species of fish. The pH observed in water is determined by a number of complex interactions and provides an overall measure of the intensity of the various acid/base interactions which are occurring.

The pH scale ranges from 1 to 14 standard units. A pH of 7 indicates neutral conditions, while waters with a pH less than 7 are acidic and those with pH values greater than 7 are basic. Since pH is expressed on a logarithmic scale, each 1 unit change in pH represents ten-fold increase or decrease in hydrogen ion concentration. Therefore, a pH of 6 would be 10 times more acidic than a pH of 7 and 100 times more acidic than a pH of 8. The pH of normal rainwater (containing no pollutants) is about 5.6. As the rainwater travels over and through rocks and soil, chemical reactions with minerals affect the pH and buffering capacity of the water.

The observed pH for most stations was usually between 6 and 8, but both high and low values were observed. Both the lowest and highest pH observed were readings of 6.0 pH units and 8.5 units at Darby Creek. The lowest mean pH was 6.5 for Stony Creek and Otter creek. Exact reasons for these low readings are uncertain.

Readings at or above pH 8 were recorded at four stations. High readings are often associated with algal blooms because algae remove carbon dioxide, a weak acid, from water as part of the photosynthesis process.

Dissolved Oxygen
The dissolved oxygen (DO) concentration of a river is an important indicator of the overall "health" of the system. A great amount of information can be obtained solely through the analysis of this

parameter. Dissolved oxygen concentrations are related to the photosynthetic activity of algae and weeds and, therefore, provide insight into productivity. Dissolved oxygen gradients provide an indication of mixing patterns and the effectiveness of mixing processes. Dissolved oxygen concentrations also have an important bearing on other physical and chemical properties, and on the composition of the biota in the river. For example, pollution sensitive species such as stoneflies (Plecoptera) and caddis flies (Tricoptera) require high oxygen levels, while other species such as midges (Diptera) can tolerate low dissolved oxygen levels. In general, species diversity increases with increasing dissolved oxygen concentration.

The amount of oxygen which can dissolve in water is subject to fluctuations caused in part by variations in temperature, photosynthetic activity, and stream flow. Respiratory processes, oxidation of inorganic wastes, and the decomposition of organic matter deplete oxygen, while photosynthesis and re-aeration by contact with the atmosphere increase oxygen concentrations in water. Dissolved oxygen concentrations are of concern because oxygen is essential for the survival of fish and many other aquatic organisms. Most desirable aquatic organisms require a dissolved oxygen concentration of 4.0 ppm or greater for long-term survival.

Dissolved oxygen concentrations were usually greater than 6 ppm at most stations; however, concentrations less than 5 ppm were observed at Stony Creek during August. Crum Creek, Marcus Hook Creek and Neshaminy Creek also recorded relatively low concentrations. Low flow conditions and high temperatures are a common cause of low oxygen readings during the summer months. It should be noted that all of these stations are in the Philadelphia metropolitan area, where numerous wastewater discharges and CSO's have historically been responsible for low oxygen readings.

High dissolved oxygen concentrations were observed at most stations in the winter months when the solubility of oxygen in water increases as a result of lower water temperatures. Several stations recorded dissolved oxygen concentrations of 13.0 ppm or higher.

Dissolved Oxygen Saturation

In addition to concentration, dissolved oxygen can be expressed in terms of percent saturation. The amount of oxygen that can dissolve in water decreases with increasing temperature and dissolved solids concentration. For this reason alone, dissolved oxygen concentrations in surface waters usually increase significantly during the winter months. By eliminating the seasonal variations caused by temperature, dissolved oxygen saturation can provide a better comparison of dissolved oxygen in water between different sampling dates than dissolved oxygen concentrations.

Dissolved oxygen saturation was closely related to dissolved oxygen concentration, but some differences were noted in station means. Sampling stations with an average dissolved oxygen saturation of less than 80 percent included Crum Creek and Stony Creek.

Nitrate (NO3-N)

Nitrogen compounds are important nutrients for algae and aquatic macrophyte growth. The common inorganic forms of nitrogen in water are nitrate (No2) and ammonia (NH3), The form of inorganic nitrogen present depends largely on oxygen concentrations. Nitrate is the principal form of nitrogen in most surface waters, but high concentration of nitrate may reflect unsanitary conditions because human and animal wastes are major sources of nitrate. Nitrite is an intermediate form which in unstable in surface waters,. Ammonia is the nitrogen form stable under anaerobic conditions. Nitrate and nitrite are often analyzed together and reported as No3 + No2-n., although nitrite concentrations are usually insignificant. Total Kjeldahl nitrogen (TKN) concentrations include ammonia, organic nitrogen and particulate organic nitrogen. Nitrogen concentrations in algal cells are typically 10 to 20 times higher than phosphorous concentrations, and many natural waters have similar nitrogen to phosphorous ratios.

Most reported nitrate concentrations were in the range of 0.8 to 3.0 ppm. This concentration is typical of unpolluted surface waters. High nitrate concentrations (>4 ppm) were observed at 5 different stations at some point during the sampling period.

Phosphate (PO4)

Phosphorous is an essential nutrient and is often the factor limiting additional growth of aquatic organisms. Total phosphorous represents the sum of all phosphorous forms, including dissolved and particulate organic phosphates from algae and other organisms, inorganic particulate phosphorous from soil particles and other solids, polyphosphates from detergents and dissolved orthophosphates. Soluble orthophosphate levels are more likely to be affected by algal consumption during the growing season.

Some of the important external sources of phosphorous are fertilizers, septic leachate, sewage effluent, detergents and soaps, particulate materials transported by stormwater, and even phosphorus.

Phosphate concentrations at most locations were generally less than 1.0 ppm. Chester Creek had a mean phosphate concentration of 0.7 ppm and was the only station with a mean phosphate concentration greater than 0.5 ppm.

Summary Values for Monitoring Parameters - PA Stations

	Depth (m)	Trans (m)	Temp (C)	pH	DO (mg/L)	DO (% Sat)	Nitrate (mg/L)	Phosphate (mg/L)
CHESTECK000.0								
Mean	1.4	1.7	16.5	7.0	8.6	87.8	1.8	.7
Minimum	.3	.3	14.5	6.5	6.6	72.0	1.0	.5
Maximum	3.1	3.1	20.0	7.5	10.0	98.0	2.6	.8
CRUMCRK000.0								
Mean	1.2	.9	13.7	7.3	7.8	72.8	2.3	.3
Minimum	.5	.3	0.0	6.5	5.4	50.0	.9	0.0
Maximum	1.5	1.5	24.5	8.0	10.4	94.5	4.4	.8
DARBYCRK000.0								
Mean	1.5	1.4	16.4	7.4	10.5	102.9	3.5	.2
Minimum	.5	.5	4.0	6.0	7.8	88.0	1.8	.2
Maximum	4.6	3.5	28.0	8.5	12.8	134.0	4.4	.4
MARCUSHK000.0								
Mean	.6	.7	16.6	7.1	9.5	93.2	2.6	.3
Minimum	.1	.1	4.0	6.5	5.3	65.0	1.7	0.0
Maximum	2.6	2.3	28.1	7.5	13.5	137.0	4.4	1.0
NESHAMIN000.4								
Mean	2.7	1.3	14.8	7.3	8.7	82.2	.8	.3
Minimum	1.3	.4	2.5	6.5	5.5	67.0	.2	.1
Maximum	3.3	3.8	26.0	7.5	11.7	91.0	.9	.8
OTTERCRE000.1								
Mean	.5	.3	18.1	6.5	7.9	80.9	1.1	.2
Minimum	.2	.1	5.0	6.0	5.3	63.0	.9	.2
Maximum	1.5	1.0	25.0	7.5	11.4	100.0	2.2	.2
RIDLEYCK000.0								
Mean	3.0	2.7	12.0	7.0	10.3	97.0	1.3	.4
Minimum	3.0	2.7	12.0	7.0	10.3	97.0	1.3	.4
Maximum	3.0	2.7	12.0	7.0	10.3	97.0	1.3	.4
SCHUYKIL000.1								
Mean	8.5	1.7	12.5	7.4	9.8	90.7	3.3	.2
Minimum	7.0	.5	2.0	6.5	7.3	68.0	.9	0.0
Maximum	13.2	3.6	24.0	8.0	13.0	108.0	4.4	.6
STONYCRK000.0								
Mean	.6	.5	14.6	6.5	7.8	78.3	1.5	.2
Minimum	.1	.1	2.5	6.5	4.2	50.0	.2	.2
Maximum	2.5	.9	25.0	6.5	10.2	96.0	3.5	.3
TACONYCR000.0								
Mean	.9	.9	12.0	7.6	9.4	86.3	2.6	.2
Minimum	.6	.6	1.0	7.0	7.1	67.0	1.8	.2
Maximum	1.4	1.4	21.0	8.0	13.6	97.0	4.4	.4
STATE SUMMARY								
Mean	1.4	1.0	15.2	7.1	8.9	86.5	2.3	.3
Minimum	.1	.1	0.0	6.0	4.2	50.0	.2	0.0
Maximum	13.2	3.8	28.1	8.5	13.6	137.0	4.4	1.0

Delaware Riverkeeper Network
Monitoring Data

Station Code: CHESTECK000.0
CHESTER CREEK

Date	Time	Wthr	Wind	Tide	Surface	Depth	Trans	Temp	pH	DO	DO%Sat	No3-N	PO4
1/05/93	1258	C	NE	O	C	3.1	3.1	14.5	6.5	10.0	98.0	2.64	.5
5/27/93	1200	C	N	O	C	.3		16.5	7.5	8.9	92.0		.8
6/08/93	1000	O	S	O	C	.7	.3	15.0	7.0	9.0	89.0		.5
6/10/93	1015	C	N	O	C			20.0	7.0	6.6	72.0	1.00	.8
Summary Values:													
Mean						1.4	1.7	16.5	7.0	8.6	87.8	1.82	.7
Maximum						3.1	3.1	20.0	7.5	10.0	98.0	2.64	.8
Minimum						.3	.3	14.5	6.5	6.6	72.0	1.00	.5

Delaware Riverkeeper Network
Monitoring Data

Station Code: CRUMCRK000.0
CRUM CREEK

Date	Time	Wthr	Wind	Tide	Surface	Depth	Trans	Temp	pH	DO	DO%Sat	No3-N	PO4
1/05/93	1418	C	N	O	C	1.0	1.0	12.5	6.5	10.1	94.5	2.64	.3
2/05/93	800	C	S	N	C	1.5	1.5	2.0	7.5	8.0	58.0	.88	.2
2/19/93	800	C	W	N	LC	1.3	1.3	0.0	7.0	10.4	72.0	.88	.2
3/02/93	800	O	W	H	C	1.4	1.4	2.5	8.0	8.6	62.0	1.76	.2
4/02/93	800	O	SW	H	C	1.3	.3	8.0	7.0	9.4	79.0	.88	.3
4/19/93	800	PC	NA	I	C	1.4	.7	11.0	7.0	5.4	50.0	3.52	.8
5/05/93	800	O	SE	O	C	1.4	.8	17.0	7.0			4.40	.3
5/18/93	800	O	NA	O	C	1.3	.7	18.5	7.0	6.4	67.0	4.40	.5
6/01/93	1530	PC	NA	H	C	1.2	1.1	21.0	7.5	7.1	80.0	2.64	0.0
6/15/93	1540	PC	W		C	1.2	1.1	24.0	8.0	6.3	76.0	2.64	.5
7/01/93	1630	O	E		C	1.2	1.1	24.5	7.5	6.1	72.0	2.64	.4
7/29/93	1300	C	N	O	C	.5	.5	23.0	7.0	7.8	90.0	.88	.3
Summary Values:													
Mean						1.2	.9	13.7	7.3	7.8	72.8	2.35	.3
Maximum						1.5	1.5	24.5	8.0	10.4	94.5	4.40	.8
Minimum						.5	.3	0.0	6.5	5.4	50.0	.88	0.0

Delaware Riverkeeper Network
Monitoring Data

Station Code: DARBYCRK000.0
DARBY CREEK

Date	Time	Wthr	Wind	Tide	Surface	Depth	Trans	Temp	pH	DO	DO%Sat	No3-N	PO4
1/06/93	1117	C	NE	O	C	4.6	3.5	12.5	6.0	11.0	102.0	1.76	.4
3/20/93	1230	PC	W	O	LC	1.0	1.0	4.0	7.0	12.8	97.0	2.64	.2
4/04/93	1930	C	NA	L	C	1.0	1.0	8.0	7.5	11.3	95.0	2.64	.2
4/19/93	1300	C	S	O	LC	1.5		15.0	7.5	12.0	100.0	4.40	.2
5/04/93	930	O	S	L	C	.5	.5	15.0	8.0	9.9	98.0	4.40	.2
5/28/93	1000	PC	S	L	C	.5		18.0	7.5	9.5	100.0	4.40	.2
6/11/93	1000	PC	N	O	C	1.5		22.0	7.5	7.8	88.0	4.40	
7/30/93	1230	PC		O	C	1.5	.9	25.0	8.5	11.0	134.0	3.52	.2
8/23/93	1700	PC		L	C	1.0		28.0	7.5	8.9	112.0	3.52	.2
Summary Values:													
Mean						1.5	1.4	16.4	7.4	10.5	102.9	3.52	.2
Maximum						4.6	3.5	28.0	8.5	12.8	134.0	4.40	.4
Minimum						.5	.5	4.0	6.0	7.8	88.0	1.76	.2

Delaware Riverkeeper Network
Monitoring Data

Station Code: MARCUSHK000.0
MARCUS HOOK CREEK

Date	Time	Wthr	Wind	Tide	Sur-face	Depth	Trans	Temp	pH	DO	DO%Sat	No3-N	PO4
1/05/93	1217	C	NE	O	C	2.6	2.3	13.0	7.5	11.5	107.0	1.76	.2
2/14/93	1330	C	NW	O	C	.6	.5	5.0	7.0	11.3	88.0	1.76	.2
2/28/93	1300	C	NW	O	C	.6	.6	4.0	7.0	13.0	98.0	3.52	.3
3/28/93	1300	O	E	O	LC	.8	.8	11.5	7.0	11.7	106.0	4.40	0.0
4/25/93	1520	PC	NE	O	C	.5	.5	17.0	7.5	13.5	137.0	1.76	.1
5/08/93	1630	C	S	O	C	.9	.9	20.0	7.5	11.7	128.0	1.70	.2
6/05/93	1400	O	SW	L	C	.1		19.5	7.0	7.8	89.0	2.20	0.0
6/27/93	1512	C	NA	O	C	.3		25.0	6.5	7.3	85.0	1.76	.2
7/11/93	1305	PC	NA	O	C	.4		28.1	7.0	6.7	84.0	4.40	1.0
7/25/93	1435	PC	NA	O	C	.3		27.0	7.5	7.5	94.0	2.64	.4
8/21/93	1300	PC	NE	O	C	.3	.1	24.0	6.5	6.6	77.0	4.40	.4
8/28/93	1217	O		O	C	.3		27.0	7.0	5.3	65.0	4.40	.6
9/25/93	1345	C	NA	O	C	.3		19.0	7.0	8.4	75.0	1.76	.2
10/10/93	1505	PC	NE	O	C	.4		15.0	7.0	8.6	85.0	1.76	.3
10/24/93	1340	C	NE	N	C	.3		14.5	7.0	9.2	90.0	2.64	.2
11/07/93	1400	C	NE	O	C	.4		9.0	7.0	10.0	85.0	1.76	.2
11/28/93	1450	PC	NE	O	LC	.8	.2	16.0	7.0	9.3	95.0	1.76	.2
12/12/93	1445	C	NE	O	C	.6		4.0	7.0	12.2	90.0	1.76	.4
Summary Values:													
Mean						.6	.7	16.6	7.1	9.5	93.2	2.56	.3
Maximum						2.6	2.3	28.1	7.5	13.5	137.0	4.40	1.0
Minimum						.1	.1	4.0	6.5	5.3	65.0	1.70	0.0

Delaware Riverkeeper Network
Monitoring Data

Station Code: NESHAMIN000.4
NESHAMINY CREEK

Date	Time	Wthr	Wind	Tide	Surface	Depth	Trans	Temp	pH	DO	DO%Sat	No3-N	PO4
2/14/93	1640	PC	SW	L	LC	3.1	.5	2.5	7.5	10.4	75.0	.88	.8
3/22/93	958	O	NE	O	C			5.0	6.5	11.7	91.0	.88	.1
4/19/93	850	PC	NE	L	LC	2.6	3.8	11.5	7.0	8.9	86.0	.88	.1
6/08/93	930	O	NE	O	C	3.3	.7	18.0	7.5	8.5	90.0	.88	.1
7/03/93	1220	PC	NE	O	C	3.2	1.0	26.0	7.5	5.5	67.0	.88	.3
8/29/93		C	NA	0	C	1.3	.4	26.0	7.5	7.0	84.0	.20	.2
Summary Values:													
Mean						2.7	1.3	14.8	7.3	8.7	82.2	.77	.3
Maximum						3.3	3.8	26.0	7.5	11.7	91.0	.88	.8
Minimum						1.3	.4	2.5	6.5	5.5	67.0	.20	.1

Delaware Riverkeeper Network
Monitoring Data

Station Code: OTTERCRE000.1
OTTER CREEK (AKA MILL CR. CZM)

Date	Time	Wthr	Wind	Tide	Surface	Depth	Trans	Temp	pH	DO	DO%Sat	No3-N	PO4
2/15/93	1500	PC	NE	O	C			5.0	6.5	11.4	88.0	2.20	.2
3/07/93	1500	C	SE	O	C	.6	.3	6.5	6.5	10.3	82.0	.88	.2
4/04/93	1300	PC	NW	O	C	.6	.1	7.0	6.5	10.0	82.0	.88	.2
5/14/93	1200	C	NW	O	C	.3	.3	21.5	6.0	9.0	100.0	.88	.2
5/30/93	1430	C	NW	O	C	.3	.3	24.5	7.5	7.9	95.0	.88	.2
6/16/93	930	C	NE	O	C	.3		22.0	6.5	5.6	65.0	.88	.2
7/02/93	1200	R	NW	O	C	.3	.3	24.5	6.5	5.9	68.0	.88	.2
7/17/93	1230	C	W	O	C			24.5	6.5	6.8	79.0	.88	.2
7/31/93	1235	C	NE	O	C	.2	.2	25.0	6.5	5.3	63.0	.88	.2
8/18/93	1235	PC	NW	O	S	.4	.4	23.0	6.5	7.0	80.0		.2
9/12/93	1215	C	SE		LC	.2		25.0	6.5	7.0	85.0	.88	.2
11/03/93	1500	O	W	H	C	1.0	1.0	10.0	6.0	8.4	75.0	1.76	.2
11/15/93	1457	C	NE	H	L	1.5		17.0	7.0	8.1	90.0	.88	.2
Summary Values:													
Mean						.5	.3	18.1	6.5	7.9	80.9	1.06	.2
Maximum						1.5	1.0	25.0	7.5	11.4	100.0	2.20	.2
Minimum						.2	.1	5.0	6.0	5.3	63.0	.88	.2

Delaware Riverkeeper Network
Monitoring Data

Station Code: RIDLEYCK000.0
RIDLEY CREEK

Date	Time	Wthr	Wind	Tide	Sur-face	Depth	Trans	Temp	pH	DO	DO%Sat	No3-N	PO4
1/05/93	1345	C	N	O	C	3.0	2.7	12.0	7.0	10.3	97.0	1.32	.4
Summary Values:													
Mean						3.0	2.7	12.0	7.0	10.3	97.0	1.32	.4
Maximum						3.0	2.7	12.0	7.0	10.3	97.0	1.32	.4
Minimum						3.0	2.7	12.0	7.0	10.3	97.0	1.32	.4

Delaware Riverkeeper Network
Monitoring Data

Station Code: SCHUYKIL000.1
SCHUYLKILL RIVER

Date	Time	Wthr	Wind	Tide	Surface	Depth	Trans	Temp	pH	DO	DO%Sat	No3-N	PO4
1/17/93	1010	PC	NE	O	LC	7.0	2.0	4.0	7.5	10.8	83.0	4.40	.2
1/30/93	1040	C	NE	O	LC	7.0	2.1	3.0	8.0	13.0	97.0	4.40	.2
2/15/93	1130	PC	W	O	LC	7.0	1.5	4.0	7.5	12.2	93.0	4.40	.4
2/27/93	1155	C	N	O	C		2.2	2.0	7.5	9.5	68.0	4.40	.0
4/01/93	1610	O	N	I	C		.5	10.0	7.0	9.5	86.0	2.64	.2
4/18/93	1220	C	NW	O	C		.5	12.0	7.0	10.8	102.5	4.40	.2
5/01/93	1145	C	N	O	C		1.0	17.0	7.5	10.1	108.0	4.40	0.0
5/15/93	1340	C	W	O	LC		1.2	20.0	8.0	8.2	94.0	4.40	.1
6/08/93	1300	PC	S	L	C	4.1	3.6	21.0	7.5	8.3	96.0	1.00	.6
7/29/93	1130	C	N	O	C		2.4	21.0	6.5	7.3	80.0	1.32	.3
9/14/93	1400	PC	N	I	C			24.0	7.5	7.6	90.0	.88	.2
Summary Values:													
Mean						6.3	1.7	12.5	7.4	9.8	90.7	3.33	.2
Maximum						7.0	3.6	24.0	8.0	13.0	108.0	4.40	.6
Minimum						4.1	.5	2.0	6.5	7.3	68.0	.88	0.0

Delaware Riverkeeper Network
Monitoring Data

Station Code: STONYCRK000.0
STONY CREEK

Date	Time	Wthr	Wind	Tide	Surface	Depth	Trans	Temp	pH	DO	DO%Sat	No3-N	PO4
1/31/93	943	C	NW	O	C	.4	.4	2.5	6.5			2.20	.3
2/14/93	1045	C	NW	O	C	.9	.9	2.5	6.5			1.76	.2
3/28/93	1150	OR	E	O	C	.9	.1	11.0	6.5	10.2	94.0	.88	.2
4/18/93	1120	C	N	I	C	.9	.8	12.0	6.5	9.2	85.0	2.20	.2
5/10/93	1150	C	NW	O	C	.1		18.0	6.5	9.3	96.0	1.32	.3
5/23/93	755	C	NA	O	C	2.5	.5	14.0	6.5	8.5	82.0	1.32	.2
6/27/93	945	O	E	O	C	.9	.9	24.0	6.5	6.8	80.0	3.52	.2
8/01/93	930	C	NA	O	C	.1	.1	23.0	6.5	5.0	56.0	.88	.2
8/29/93	1800	C	NA	O	C	.3		25.0	6.5	4.2	50.0		.2
9/26/93	1745	C	NA	O	C	.5	.5	22.0	6.5	7.7	90.0	1.32	.2
10/17/93	1050	O	NA	L	C	.1		17.5	6.5	7.6	80.0	1.32	.2
11/21/93	745	C	NW	O	C	.1		4.0	6.5	9.3	70.0	.20	.2
Summary Values:													
Mean						.6	.5	14.6	6.5	7.8	78.3	1.54	.2
Maximum						2.5	.9	25.0	6.5	10.2	96.0	3.52	.3
Minimum						.1	.1	2.5	6.5	4.2	50.0	.20	.2

Delaware Riverkeeper Network
Monitoring Data

Station Code: TACONYCR000.0
TACONY-FRANKFORD CREEK

Date	Time	Wthr	Wind	Tide	Sur-face	Depth	Trans	Temp	pH	DO	DO%Sat	No3-N	PO4
1/15/93	1445	O	NW	O	LC	.8	.8	5.0	7.5	8.4	67.0	2.64	.2
2/05/93	1500	C	W	O	LC	1.1	1.1	1.0	8.0	13.6	97.0	4.40	.2
3/23/93	1500	O	NE	O	C	1.4	1.4	5.0	7.0			2.64	.2
4/17/93	1800	PC	NW	O	LC	1.0	1.0	10.0	7.5	11.0	96.0	1.76	.2
5/14/93	1330	C	SW	O	C	.8	.8	21.0	8.0	8.6	95.0	1.76	.4
5/29/93	1500	C	S	O	C	.9	.9	21.0	8.0	7.7	85.0	2.64	.2
6/14/93	1400	C	NA	O	C	.6	.6	21.0	7.0	7.1	78.0	2.64	.2
Summary Values:													
Mean						.9	.9	12.0	7.6	9.4	86.3	2.64	.2
Maximum						1.4	1.4	21.0	8.0	13.6	97.0	4.40	.4
Minimum						.6	.6	1.0	7.0	7.1	67.0	1.76	.2

Delaware Riverkeeper Network
Observation Summaries

CRUMCRK000.0
CRUM CREEK

Test Date: 2/05/93
Comments: WATER MOVING SLOW, A LOT OF GARBAGE IN THE WATER.

Test Date: 2/19/93
Comments: VERY COLD.

Test Date: 3/02/93
Wildlife: SQUIRREL
Comments: GARBAGE IN STREAM.

Test Date: 4/19/93
Wildlife: BIRDS
Comments: WATER MURKIER THAN USUAL

Test Date: 5/05/93
OtherObs: PROBLEM WITH DO READING
Comments: MUCH MURKIER WATER, ALGAE BLOOM?

Test Date: 5/18/93
OtherObs: (NO PRECIP. MEASURE GIVEN)
Comments: MORE GARBAGE IN STREAM AREA, WATER CLOUDIER, MURKIER

Test Date: 6/01/93
Wildlife: STARLING
Comments: ALGAE ON ROCKS IN CALM AREAS. WATER HAS DIRTY SUDS IN IT.

Test Date: 6/15/93
Wildlife: CRAPPIE FISH, SUNFISH, STARLING
Comments: FIRST EVER FISH SIGHTING. (NO PRECIP. MEASURE GIVEN)

Test Date: 7/01/93
Wildlife: STARLING, 8-10" FISH (TROUT?), SMALLER FISH AS WELL
Comments: TREES CUT & TRIMMED, WATER RECEIVES MUCH MORE SUN

Test Date: 7/29/93
Wildlife: 6 SMALL (1 - 2 ") FISH

Delaware Riverkeeper Network
Observation Summaries

CHESTECK000.0
CHESTER CREEK

Test Date: 5/27/93
Comments: ERROR IN NITRATE READING

Test Date: 6/08/93
Comments: OILY SHEEN. NITRATE READING INCORRECT

Delaware Riverkeeper Network
Observation Summaries

DARBYCRK000.0
DARBY CREEK

Test Date: 1/06/93
Wildlife: MALLARDS, GEESE, GREEN HERON

Test Date: 3/20/93
Wildlife: SQUIRRELS, MALLARDS
OtherObs: (NO PRECIP. MEASURE GIVEN.)
Comments: LEAF DUST FLOATING ON SURFACE OF WATER. MUD BY CREEKBANK.

Test Date: 4/04/93
Wildlife: RACOON TRACKS, GEESE
Comments: NO PRECIP. MEASURE GIVEN.

Test Date: 4/19/93
Wildlife: RED & YELLOW TURTLE, BIRDS, SMALL MINNOWS
OtherObs: CLARITY MUCH BETTER ON DARBY CR. THAN ON COBBS CRK.
Comments: NO PRECIP. MEASURE GIVEN.

Test Date: 5/04/93
Wildlife: SCHOOLS OF MINNOWS IN SIDE CREEK, 2' CARP.
OtherObs: VEG. MATTER & OIL BLOTCHES ON COBBS CRK.
Comments: WATER LEVEL VERY LOW @ LOWTIDE IN BOTH CRKS.

Test Date: 5/28/93
Wildlife: CARP(5-6) SCHOOLING, SMALL MINNOWS, BIRDS
Comments: NITRATE NEAR LIMIT OF TEST

Test Date: 6/11/93
Wildlife: RACOON TRACKS, NUMEROUS PAUFISH FRY IN WATER.
Comments: WATER CLARITY/EXCEEDS DEPTH-SLIGHTLY CLOUDY W/SILT

Test Date: 7/30/93
Wildlife: WHITE EGRET
OtherObs: VERY TRASHY LOOKING WATER. SCATTERED OIL SLICKS, VEGETATION
Comments: WATER VERY CLOUDY. HEAVY POLLEN LAYER ON SURFACE.

Test Date: 8/23/93
Wildlife: WATERFOWL FOOTPRINTS, WHITE EGRETS (3)
OtherObs: AREA HAS BEEN FLOODED AND INACCESSIBLE. GREAT AMOUNT OF
Comments: SILTING ON BARKOF COBBS CREEK/INCREASE SILTING ON DARBY CRK

Delaware Riverkeeper Network
Observation Summaries

MARCUSHK000.0
MARCUS HOOK CREEK

Test Date: 2/14/93
OtherObs: SOAPY DISCHARGE FROM PIPE ON RT. BANK DOWNSTREAM 60 YDS.
Comments: NO PRECIP. MEASURE GIVEN.

Test Date: 2/28/93
Comments: TRASH IN STREAM. (NO PRECIP. MEASURE GIVEN)

Test Date: 3/28/93
Comments: NO PRECIP. MEASURE GIVEN.

Test Date: 4/25/93
OtherObs: PIPE DRAINING INTO WATER, SOAPY. RUSTLIKE MATERIALS IN WATER
Comments: A LOT OF TRASH IN RIVER. (NO PRECIP. MEASURE GIVEN)

Test Date: 5/08/93
Comments: NO PRECIP. MEASURE GIVEN.

Test Date: 6/05/93
OtherObs: DISCHARGE FROM PIPE 50 YDS UPSTREAM, (NO PRECIP. MEASURE)
Comments: WATER SURFACE COVERED W/FILM, DEBRIS FROM TREES.

Test Date: 9/25/93
Comments: DEBRIS - CHAIR, PIPE ETC. IN STREAM

Delaware Riverkeeper Network
Observation Summaries

NESHAMIN000.4
NESHAMINY CREEK

Test Date: 2/14/93
Wildlife: GULLS
Comments: WATER APPEARED CLOUDY. HIGH PO4 READING, NO PRECIP. MEASURE.

Test Date: 3/22/93
Wildlife: GULLS
OtherObs: NO PRECIP. MEASURE GIVEN.
Comments: SWIFT CURRENT DUE TO SNOWMELT, HEAVY RAIN, SEC. DISK USELESS

Test Date: 4/19/93
Wildlife: MALLARDS
Comments: SITE NOW AT JACK'S MARINA. PRECIP. UNKNOWN - NO GAUGE

Test Date: 6/08/93
Wildlife: MALLARDS WITH DUCKLINGS
Comments: STRONG CURRENT IN WATER

Test Date: 8/29/93
Wildlife: MALLARDS, GULLS

Delaware Riverkeeper Network
Observation Summaries

SCHUYKIL000.1
SCHUYLKILL RIVER

Test Date: 1/17/93
Wildlife: PIGEONS, GULLS
Comments: NO PRECIP. MEASURE GIVEN.

Test Date: 1/30/93
Wildlife: GULLS, PIGEONS

Test Date: 2/15/93
Wildlife: GULLS, PIGEONS
Comments: WATER BROWN AS USUAL.

Test Date: 2/27/93
Wildlife: GULLS
Comments: H2O TEMP & DO LOWER THAN USUAL. (NO PRECIP. MEASURE GIVEN)

Test Date: 4/01/93
Wildlife: PIGEON
Comments: BROWN WATER, SOME DEBRIS. PRECIP. UNKNOWN. FAST CURRENT.

Test Date: 4/18/93
Wildlife: PIGEONS, GULL
Comments: MURKY BROWN WATER, FAST CURRENT, DEBRIS (STICKS, ETC.)

Test Date: 5/01/93
Wildlife: PIGEONS, GULLS
Comments: GREEN-BROWN WATER, FAST CURRENT.

Test Date: 5/15/93
Wildlife: PIGEONS
Comments: WATER IS CLOUDY, GREEN-BROWN, MOVING FAST.

Test Date: 6/08/93
Comments: NO PRECIP. MEASURE GIVEN.

Test Date: 9/14/93
Wildlife: DOUBLE-CRESTED CORMORANT

Delaware Riverkeeper Network
Observation Summaries

STONYCRK000.0
STONY CREEK

Test Date: 1/31/93
Wildlife: GEESE, FINCHES, SPARROWS
Comments: DO SAMPLE DID NOT TURN CLEAR.

Test Date: 2/14/93
Wildlife: SPARROWS, FINCHES, CARDINALS, GEESE
OtherObs: NATURAL AND TRASH DEBRIS IN WATER.
Comments: WATER CLEAR. (NO PRECIP. MEASURE GIVEN). DO DID NOT TURN.

Test Date: 3/28/93
Comments: WATER VERY CLOUDY, LOTS OF SEDIMENT.

Test Date: 4/18/93
Wildlife: BIRDS

Test Date: 5/10/93
Wildlife: CARDINALS, ROBINS, SPARROWS
Comments: WATER VERY CLEAR

Test Date: 5/23/93
Wildlife: FINCHES, CANADA GEESE
OtherObs: MORE THAN A CENTIMETER OF RAIN
Comments: CREEK OPAQUE TAN COLOR(LOOKS LIKE MILK DUMPED IN WATER)

Test Date: 6/27/93
Wildlife: FINCH, SPARROWS
Comments: OVER 10 MM OF RAIN

Test Date: 8/01/93
Wildlife: ASSORTED BIRDS

Test Date: 8/29/93
Wildlife: CICADAS
Comments: PERCIP APPROX 25MM

Delaware Riverkeeper Network
Observation Summaries

TACONYCR000.0
TACONY-FRANKFORD CREEK

Test Date: 1/15/93
Comments: NO PRECIP. MEASURE GIVEN.

Test Date: 2/05/93
Wildlife: GULLS, RATS
Comments: A LOT OF SUBMERGED LITTER.SLICK NOTED ON WATER SURFACE.

Test Date: 2/18/93
Comments: WATER SAMPLE NOT TAKEN DUE TO ICING CONDITIONS AND HIGH WIND

Test Date: 3/23/93
OtherObs: FECAL COLLIFORM PRESENT IN SAMPLE AT HIGH LEVELS.
Comments: NO DO READING GIVEN. WATER DEPTH HIGH DUE TO RAIN & SNOWMELT

Test Date: 4/17/93
Comments: ALGAE ON SURFACE OF WATER. (NO PRECIP. MEASURE GIVEN)

Test Date: 5/14/93
Wildlife: MINNOWS
Comments: HEAVY ALGAL BLOOM

Test Date: 5/29/93
Wildlife: CATFISH, CARP, MINNOWS
Comments: ALGAE PRESENT, TRACE OF PRECIPITATION

Test Date: 6/14/93
Wildlife: SUNFISH, MINNOWS, CATFISH, EELS, CARP
OtherObs: NO VISIBLE ALGAE. WATER UNUSUALLY CLEAR
Comments: FECAL COLLIFORM PRESENT IN SAMPLE.*SEE NOTE ON DATA SHEET.